

# Results of International Partnerships: Modernization of Engineering Education in the Light of the Bologna Declaration

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## Abstract

This paper describes the transition of the educational process in the Siberian State University of Telecommunications and Information Sciences to the Bologna-style higher education system based on two main cycles (Bachelor's and Master's). It considers the basic problems regarding the creation of modern educational technologies in higher education and issues of organizational, technical and methodical maintenance of training processes. This paper presents the model of an electronic dean's office with various subsystems.

The authors of this paper discuss alterations in subject-object relations between an instructor and a student in new educational paradigm, when students direct their own learning-cognitive activities. When implementing new pedagogical technologies, such as distance learning, instructors are facing the problem of creating an educational environment that allows students to control such a kind of activity. A deficiency in communication during the study can cause an inability to create a favorable psychological climate and comfortable conditions for learning. An insufficient amount of communication activities can also lead to a decreasing of interest in learning up to complete loss of motivation to study through the new technologies. The new educational environment brings about new learning situations and social relationships.

In this article the results of marketing research conducted at the Siberian State University of Telecommunications and Information sciences are given. The goals of the research were to reveal causes of consumers' behavior on the distance learning services market, understanding the nature of this behavior, defining effective channels for distance learning advancement and of ways of motivating potential consumers by means of marketing communications.

## Keywords

*E-learning; Distance Learning; Modernization of Engineering Education*

## Introduction

International cooperation of SibSUTIS began in 1996 and continues to this day. During this long period SibSUTIS has participated in the following international projects: "Increase of Students Mobility in the Field of Economics" (2001-2004), "Master Degree Program in Telecommunication Informatics" (2005-2008), "Reform of ICT Curriculum" (2006-2009), and "Two cycle E-Commerce curricula to serve Information Society in RU, UA, IL" (2011-2014). The most active international cooperation SibSUTIS has conducted was with the European universities: Universita Degli Studi Dell'Aquila (Italy), Deutsche Telekom Fachhochschule (Leipzig, Germany), and Bremen Hochschule (Germany).

International partnerships have successfully implemented the objectives according to the Bologna principles. The first goal that has been achieved is the implementation of the Bachelor's and Master's Degrees in Information and Communication Technologies and creating to meet the demands of the Russian labor market. The academic mobility of instructors and students on the basis of using European Credit Transfer System (ECTS) was also successfully realized. During the academic mobility of instructors the problem of primary importance was to implement e-learning technologies and methodologies into this new two-level system. Implementation of the new educational technologies inevitably caused major modifications in

## SibSUTIS education.

The rest of this paper is organized as follows. Section II presents the implementation of modern educational technologies into SibSUTIS educational process. Section III describes what major modifications took place in the SibSUTIS training system as a consequence of this implementation. It also presents the results of two researches related to the application of new educational technologies such as e-learning. Section IV concludes the paper.

## Implementation of Modern Educational Technologies

The experience of the European universities indicated that in order to organize e-learning at the workplace via the Internet, it is necessary to satisfy three conditions: to create an information-educational environment, to organize feedback between students and instructors, and to provide management to the training process (J.A.Day J.D.Foley, 2006; H.C.Lin, 2006; E.Sakkopoulos et al, 2006). Implementation of a model of the three layers network educational system became the result of the cooperation of SibSUTIS with European universities. (Fig.1). This network educational system is based on the Internet channels and Internet technologies. The second layer of this model corresponds to the information technologies implemented in the Internet. Finally, the top and bottom layers of the model correspond to educational technologies incorporated in the triune educational system that includes the electronic educational environment, means for information interaction, and means for management of the training process.

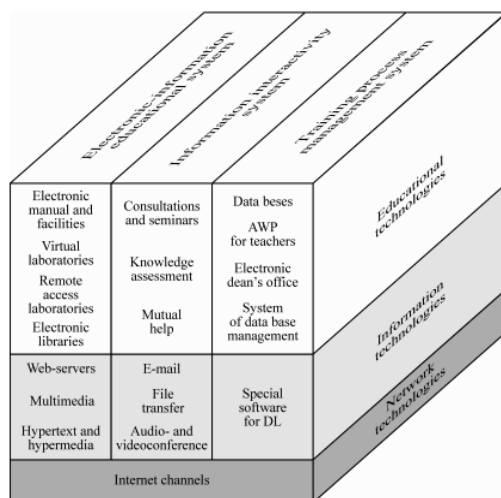


FIG. 1 THE MODEL OF THE NETWORK EDUCATIONAL SYSTEM ON THE BASE OF NETWORK INFORMATION TECHNOLOGIES

Along with Internet channels, the following tools were used as the basic elements of the distance educational system in the model: hypertext, multimedia, Web-servers, transmission facilities in the form of e-mail, teleconferences, file transfers and software for PCs.

In order to organize the Internet-training process and its management, a corresponding environment, organizational-administrative maintenance, technical maintenance and methodical maintenance were created.

## Organizational-administrative Maintenance of the Training Process

An important element of the organization of the training process is preparation and constant updating of teaching materials on a Web-site. The teaching materials need to meet the requirements of self-sufficiency (i.e. to contain all that is necessary for independent studying), interactivities (i.e. to provide the maximal information interaction between a trainee and an educational institution), availability (i.e. to give an opportunity of access to any available resources), motivation (i.e. to interest a trainee to work with the material), and multimedia (i.e. to use the text, figures, sound, animation, video, etc.). Development and administrative support of a database play a significant role as the contingent of trainees reached several thousand people; the number of disciplines changed from several tens to several hundreds.

The duty of the personnel engaged in the planning of the training process includes drawing up curriculum of specialties and schedules of courses, timetables of electronic consultations and examinations. All necessary documents were placed on a Web-server available to various categories of users.

The primary mean of public communication was a forum. The trainee could ask any questions and receive appropriate explanations.

## Technical Maintenance of the Training Process

Distance learning needs serious technical support. The availability of a local network and several servers in an educational institution, and organizing the Internet-training, leads to the necessity to be engaged in an administration of a network and servers.

The main carrier of the educational information is the Web-server. Web-pages containing teaching material and necessary information for the organization of the training process were created, and functioned on the Web-server.

Tool envelopes were developed in order to check the

tests by a supervising program located on a server.

### *Methodical Maintenance of the Training Process*

The keystone to success in organizing the Internet training is a constant methodical support for the training process, a continuous system of teachers' training and an exchange of experience between teachers.

### *Management System of E-learning*

The management system of e-learning developed at SibSUTIS contains a number of various subsystems: subsystem of user authorization, subsystem of user access rights assignment, subsystem of user passwords assignment, subsystem of input and revision of students' data, subsystem of input and revision of teachers' data, subsystem of student progress record, subsystem of teaching load record, and subsystem of curricula.

All subsystems include a search engine and data filtrations which help to easily and quickly find data on the progress of a given student. The filter allows the user to see the progress of students from one group or for one subject.

The support system for e-learning at the workplace fulfill functions which include the design of learning courses, teaching of students via the Internet, management of the training process, and support of the e-library. In the process of e-learning organization three categories of users took place. They were students, teachers and administrators of the training process. The support system for e-learning at the workplace provides communication and interaction among users and administrators of the training process (Fig. 2).

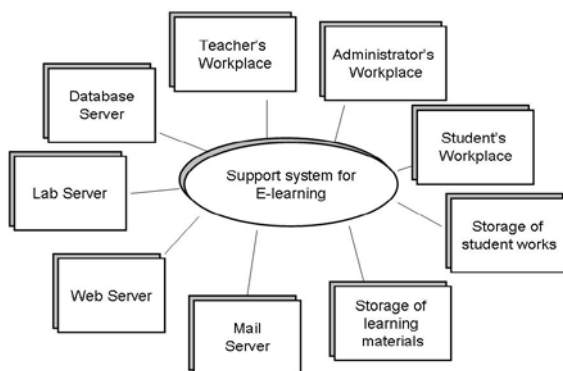


FIG. 2 STRUCTURE OF THE SUPPORT SYSTEM FOR E-LEARNING AT THE WORKPLACE

Learning courses developed by instructors get archived and are stored on the server. The database

server is used to manage e-learning databases which contain the data about students, instructors, managers, curriculum, learning specialties, subject, learning progress, and instructors' reviews. The Web-server provides an access to the e-learning recourses for all users. Functions of the Web-server include: publishing of information, reference and learning materials, access to the database, and storage of learning materials. The server of a remote laboratory allows students to work with devices and equipment in a remote access mode. The storage of student's works included all works performed by students and sent by email as archived files. In order to send student's works and information, teachers and managers use a special mail service.

Automated workplaces for students, teachers and e-learning administrators are workstations where browsers provide access to the e-learning resources.

### *Major Modifications in SibSUTIS Educational Process*

The human drive to discover and explore the surrounding world makes learning a lifelong process. Education consists of two primary needs; the need to receive information, and the need to learn about the surrounding world (cognitive learning). Satisfaction of the informational need relates to obtaining and using information, whereas the cognitive need relates to obtaining and using knowledge. Analysis of the information-knowledge correlation allows one to understand how information gathering activities relate to the perception and use of that information in the process of communicating, while cognitive, or creative, activity is aimed at obtaining new knowledge. The formation of the subject's (student's) thesaurus is aimed at addressing both the informational and cognitive needs (V.Z. Kogan & V.A Uhanov, 1991).

Self-directed cognitive leaning has become increasingly important with the introduction of internet-based education, distance learning, e-learning and m-learning. These educational models allow the student to focus their learning, while still remaining under the control of an instructor. Students should be able to form their own learning methods; however these methods should not deviate significantly from the framework provided by the instructor. The modern learning process works in conjunction with the student's individual learning style. In regards to cognitive learning, this educational process is on one hand under the control of the instructor, as the facilitator, and on the other hand under the control of the self-directed student. Initially,

the instructor is responsible for developing the framework under which the student should function.

The goal of Self-Directed Learning (SDL) is to develop the student's individual learning style to gain specific knowledge of a subject field. Personal development requires gradually stepping away from teacher-controlled models to a more personalized SDL style of learning. As a result of the SDL model self-discipline, knowledge and understanding increase. At the foundation of the SDL model is the understanding that the instructor creates the initial framework, and direct the process of the student's self-learning activity (O.B. Zhuravleva et al, 2006; H.J.C.Ellis, 2007; F.G.Splitt, 2003; B.Dutch et al, 2001; C.Chou, 2003; C.Evans & K.Sabry, 2003; B Bannan-Ritland, 2002; A.Bohne et al, 2002).

The concept of SDL is based on subject-object relations through the process of training-informative interaction. When defining the roles of the "subject" and "object", "subject-object" information interaction should be taken into account. Activity analysis implies gathering information from an activity source, its direction and the process of the student's self-learning activity. A student's need to obtain and learn information will not be satisfied if an instructor is not available to act as the source of information. Since the instructor develops the framework of the learning process, he/she may be considered as the subject of the learning process. Alternatively, the student acts as the object of the learning process.

The term "interaction" implies contrasting activities, or roles (i.e. interactions between an object and a subject). The moment of interaction occurs when the subject (who conveys the information) receives information about the object via feedback. Feedback allows the teacher to make improvements to the methods and means of teaching.

The mechanism of learning and education is subject-object relations in info-interaction. The purpose of learning and education is to teach an individual how to solve problems which require unconventional methods of approaching and this, in turn, supposes a high level of intelligence and the ability to think independently. The main objective of any learning is to form student's intelligence and to prepare the student for a certain intellectual (professional) activity. Intelligence cannot develop out of info-interaction. The analysis of the subject-object relations shows that this activity is based on the following circumstances. Cognition process occurs

due to a specific mechanism – information interaction. Info-interaction is founded on the subject-object relations established between the subject (instructor) and the object (student). The object's activity depends on the subject's activity: the instructor may suppress student's cognitive interest or on the contrary, develop the student's interest to the level when high intellectual abilities are formed. If there is a feedback channel from the object to the subject, it allows the subject to improve the object's learning-cognitive activity and to create conditions for the SDL.

When the conditions needed for the SDL are created abilities for self-direction, self-control, self-education and self-development become the most essential things for the object. In this case the student transforms into a true subject of the learning-cognitive activity; furthermore activity of the student's information interaction considerably increases. Only an active person proving to be an individual in learning and influencing on the whole learning process may act as the subject of the learning-cognitive activity.

One of the major problems for instructors is to create an educational environment that allows students to direct their own learning-cognitive activity (F.G.Splitt, 2003). The SDL assumed particular importance at the time when on-line learning made its appearance (H.J.C.Ellis, 2007). According to the theory of SDL, the student develops his/her own learning and cognitive activity within the framework of the model developed by the instructor (C.Chou, 2003; C.Evans & K.Sabry, 2003; D.W.Dearholf et al, 2004).

An example of implementation of the SDL process in on-line courses with the usage of dynamic training elements (DTE) is designed on the principle of the cybernetic model of cognitive process management (B.I. Krouk & O.B. Zhuravleva, 2009).

Introducing DTE into the learning process enables students to direct their own learning process. Using the DTE in on-line learning, students learn to solve practical problems faster, to understand the theory much better than they do when they solve the standard problems and do the usual exercises offered in the standard circuit theory course. The use of the DTE as a supplement to the regular classroom setting may improve this situation by creating a self-directed learning environment and achieving the goal of adaptive learning (; A.Bohne et al, 2002; J.Garofalakis et al, 2002; V.Petridis et al, 2003).

Self-directed learning with the DTE is a person-oriented

and student-centered teaching method. Heidi J.C. Ellis points out (H.J.C.Ellis, 2007) that the SDL allows students to determine their learning requirements and goals and to select resources to achieve these goals and to assess the outcomes of the learning process.

In distance learning students receive psychological support from their communication activity. Being isolated from the educational institution and lacking constant communication with instructors and students, the student may experience psychological discomfort. Therefore, for this type of learning it is very important to set up constant contacts of the students with the administration of the educational institution, instructors and colleagues, who are geographically isolated. Such communication contacts enable instructors to answer students' questions promptly, to identify difficulties which the students face, and to give them support. Students in turn can compare their progress in learning with the progress of other students and to render mutual assistance.

Personality plays a very important role in human communication. For many students the personality of the teacher determines their attitude to the subject they learn. Participants of interpersonal communication influence each other through facial expressions, gestures and voice timbres. Nonverbal communication increases the efficiency of the communication process. When shifting to new types of learning, it is necessary to take measures compensating the lack of the interpersonal communication. The educational process should be considered as interpersonal interaction in "teacher-student" and "student-student" systems aimed at formation of a theoretical and practical thinking and development of the personality of a future specialist. A lack of communication activity in the learning process can cause several problems: lack of interpersonal contacts, inability to create favorable psychological climate and comfort conditions for learning, lack of efficient control of students' achievement, inability to organize a team work of students; incorrect perception and interpretation of teaching materials; interest decrease in learning up to complete loss of motivation to study through new technologies.

Various kinds of electronic communication can be organized via the Internet: informing students (bulletin board, student portfolio, visit cards);

individual and group consultations for students (e-mail, mailing lists, news group, audio- and video conferences, forums); electronic workshops (mailing lists, group news, e-conferences, forums); teamwork in small groups (forums, whiteboard); student mutual help (e-mail, mailing lists, news group, conferences, forums, social networks); monitoring of the student's progress (e-mail).

In order to organize efficient distance learning via the Internet one should take into account characteristics of the telecommunication environment and human behavioral features in this environment. A new communication environment creates new learning situations and new learning relations.

TABLE 1 SURVEY QUESTIONS AND SUMMARY OF RESPONSES

| Questions to evaluate the level of the course organization  | Average result |
|---|----------------|
| 1. How would you rate the quality (user-friendly, connection) of the Distance Learning (DL) website and access to information on the website?                             | 4.43           |
| 2. How would you rate the user friendliness of the DL website?  | 4.48           |
| 3. How would you rate the usability of the overhead information (public bulletin boards, software, training schedules, visit cards, timetables of consultations and etc.) | 4.84           |
| 4. How would you rate the quality of lectures (content, easy to understand, available examples, self-control questions)?  | 4.57           |
| 5. How well did the practical part of the course contribute to a better understanding of training materials?  | 4.62           |
| 6. How well were your knowledge and skills controlled?  | 4.43           |
| 7. How well did the means of self-control contribute to a better understanding of training materials?   | 4.15           |
| 10. How did you feel about communicating with other trainees (your colleagues)?   | 4.9            |
| 11. How would you rate the feedback of the course administration?   | 4.62           |
| 12. How did you feel about discussing problems on the forum?  | 4.79           |
| 13. How well did the course contribute to obtaining of new knowledge and skills?  | 4.29           |

In order to find out the success of the introduction of modern educational technologies in SibSUTIS two researches were conducted. The first research was aimed at students' assessment of the implemented e-learning technologies into the educational process (on a

five-point rating system). For this purpose 300 students of a management specialty were questioned. Results of the research are presented in Table 1. Practically all students appreciated the efforts of SibSUTIS administration to implement the distance-learning system into the learning process. Table 1 shows that the average score for all the items is higher than 4.

The goal of the second research was the determination of social-demographic features of those students who decided to study in SibSUTIS using new technologies (E.Strukova & B. Kruk, 2011).

Distance learning via the Internet becomes more and more appealing. SibSUTIS has been using distance learning technologies for higher education services for more than 10 years (Zhuravleva et al, 2007). The number of students studying distantly is steadily increasing. It is illustrated by the diagram on Fig. 3, where the dynamics of student enrollment in distance learning courses since 2000 to 2012 is shown.

Trainees have quickly estimated advantages in such kind of training. It is especially convenient for working people who are the majority among "distance" trainees. All the materials required for training (the theoretical material, laboratory and practical classes) are on the website of the university. They communicate with instructors teachers through e-mail and leave for the university at the end of the training to take graduation examinations and to defend degree thesis.

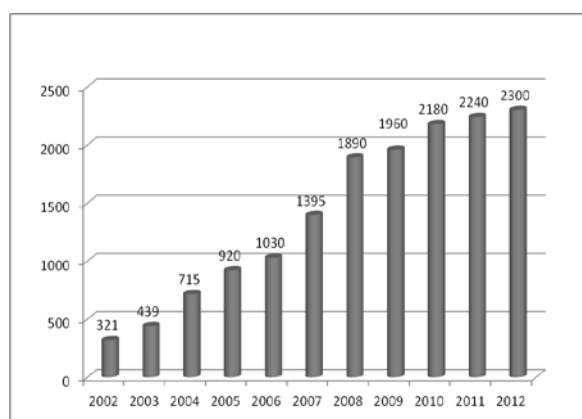


FIG. 3 DYNAMICS OF STUDENTS' ENROLLMENT IN DISTANCE LEARNING

Today more than 2,000 employees from the Russian telecommunication and information technology companies are trained at the university.

The second research was aimed at a market segmentation of the Internet-training consumers

using the database of the university. Classification of distance learning trainees was made by the following criteria:

- Geographical (region of trainees' residing, type of settlement).
- Socially-demographic (age, sex, educational level, occupation and its connection with the specialties obtained by distance learning at SibSUTIS).
- Affiliation to the various telecommunication enterprises.

The research showed that in general the consumers of the distance learning services at SibSUTIS were citizens of Siberian, Ural and Far East districts because they had been better informed about the availability of distance learning in SibSUTIS than citizens of other districts. In turn, their informativity was caused by the geographical position of SibSUTIS. Many of them were graduates from SibSUTIS and the majority worked in telecommunication enterprises. It is interesting that the share of trainees from administrative centers was approximately equal to the share of trainees from countryside. It is explained by the availability of the given form of training to the population of remote areas.

According to the results of the segmentation research the main consumers of the distance learning were people from the age from 30 to 39 years (41 %), and young men at the age under 30 years (36 %). However, there was a more senior age category - from 40 to 49 years (21 %) and even trainees at the age of 50-60 years continue their education.

In this connection marketing study assumes analysis of consumer preferences. The object of the research is the market segmentation by the introduced specialties.

Distance learning trainees have a different social status and a professional level. The average of the employees of economic sectors (i.e. economists, bookkeepers, and sales managers) is interested in economic education. Technical industry workers prefer to obtain education in technical specialties.

Most of the distance learning trainees are technical and engineering employees. They want to update the knowledge received many years ago, or to raise their education level after graduation from a technical school and a college.

The analysis revealed the main motives of employees to enroll in the distance learning: an opportunity of a career development and consequently an increase of incomes.

The market of distance learning differs from the market of traditional face-to-face learning. On one hand distance learning has not gained the necessary confidence of the majority of telecom employees. On the other hand they note definite advantages of using Internet technologies in learning: studying while at work, remaining in one location with no need to travel, and planning own training. The survey has demonstrated that the majority of trainees (93.2%) find distance learning interesting and not less valuable than traditional learning. Approximately 74.4% of trainees from telecommunication industry are fully satisfied with the distance learning and have no doubts about choosing this format of learning. Almost 97% of trainees are going to complete a full course of the distance learning program and to get a degree. About 74% of trainees would chose distance learning again if they were to make a choice.

Another survey revealed what the motivation of employees to choose distance learning was and telecom employees enrolled for distance learning courses in SibSUTIS were questioned. The questionnaire demonstrated that 47% of respondents chose the distance learning because of its advantages (i.e. they were already motivated to learning via the Internet). Approximately 29% of respondents followed advice of friends or those who have already studied distantly.

## Conclusion

E-learning via the Internet becomes more and more appealing. Siberian State University of Telecommunications and Information Sciences has been using e-learning technologies for higher education services for more than 10 years. The number of students studying distantly at the workplace is steadily increasing.

The modern system of education should help students manage their learning-cognitive activity, and consequently, personality development of the student. The student has to depart step-by-step from learning under the instructor's control to self-directed learning. Owing to the self-directed learning activity the student has to turn from the object of the teacher's influence into the subject of learning-cognitive activity. In the issue of such transformation the efficiency of the education increases considerably.

The formation of the student's intellect and knowledge is based on information interaction between the student and the teaching material.

Therefore, it is important to analyze axiological characteristics of the electronic educational environment, notably a pedagogical value and a pedagogical usefulness.

Besides using new educational technologies (internet-learning, distance-learning, m-learning) students receive comprehensive psychological assistance through their communication activity. Thus, the organization of the efficient learning in a new educational and communication environment requires taking into account the characteristics of this environment and human behavioral features in it.

Students have quickly estimated advantages of such kind of training. Results of the questioning demonstrated the assessment of a general satisfaction of the graduating students with the distance learning course. Approximately 23% of graduating students were fully satisfied; about 58% of graduating students were mainly satisfied and only 19% of graduating students were partially satisfied with the distance learning course. It is necessary to notice that there were no unsatisfied graduating students.

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